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Palynofacies as a tool for high-resolution palaeoenvironmental and palaeoclimatic reconstruction of Gondwanan post-glacial coal deposits: No. 2 Coal Seam, Witbank Coalfield (South Africa)

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Abstract The early Permian movement of Gondwana away from the South Pole caused a major climatic change across the continent. The shift from a post-glacial Carboniferous flora to a temperate Permian flora is represented in the palynological record. Using palynofacies analysis, this climate transition can be studied at a high resolution, and the palaeoenvironment can be interpreted on a local scale. Core samples were studied from four localities of the Artinskian/Kungurian-aged No. 2 Coal Seam of the Witbank Coalfield. At some localities, the No. 2 Coal Seam is split into an Upper Coal Seam and a Lower Coal Seam by an intraseam parting, and samples were collected from both horizons as well as the parting. All samples were studied with respect to palynomorph composition and phytoclast content. The results suggest a swamp-dominated environment in the Lower Coal Seam, a river-dominated environment in the parting, and an environment which fluctuated locally from a lake-dominated to swamp-dominated in the Upper Coal Seam due to increased input of glacial meltwater from the hinterlands. The vegetation switched from a fern- and conifer-dominated flora in the Lower Coal Seam to a more diverse *Glossopteris-Gangamopteris* flora in the Upper Coal Seam. *Cordaites* appears to be limited to valleys on the northern edge of the swamplands in the Lower Coal Seam. A decrease in monosaccate pollen grains and an increase in bisaccate pollen grains are apparent in all sample sets and interpreted to indicate a transition from a cold to a fluctuating cool-temperate climate. This climate signal is well documented in palynofacies of the coal seam and thus a powerful correlation tool for high-resolution basin-wide and Gondwanan correlation.

Keywords Palynofacies · Palaeoenvironment · Palaeoclimate · Permian · Witbank Coalfield · South Africa

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Introduction

The near continuous deposition of sediments in the Main Karoo Basin in South Africa from the late Carboniferous (Pennsylvanian) to the Middle Jurassic captures an extensive period of climate change from a glacial through to a dry arid climate (Falcon et al. 1984). The coal deposits of the Witbank Coalfield and more specifically the No. 2 Coal Seam captures a crucial climatic shift in the Permian. As glaciers receded, the climate and environment supported the development of peat-forming wetlands in the north-eastern part of the Main Karoo Basin. In areas with such well-developed floral assemblages, one of the best methods of reconstructing the palaeoclimate and palaeoenvironment is palynology. A palynological assemblage reflects its parent plant community which in turn is controlled by the climatic and environmental conditions (Gastaldo 1994). This makes palynofacies a powerful tool to document changes in climate and environment on high time resolution at multiple localities. It also allows for the development of new methods of correlating the South African coalfields for exploration of potential remaining coal resources in the northern part of the country which is especially important in light of the current energy crisis affecting South Africa. The